Carleton UNIVERSITY

Data assimilation of CrIS and TROPOMI satellite CO concentrations and its potential for constraining global OH

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Research Overview

Purpose:

- Use global tropospheric CO concentrations to inversely calculate the global mean OH concentration
- Why use CO?
  - Primary sink is OH
  - Global measurements improving
  - Not assessed as trace gas for OH

Expectation:

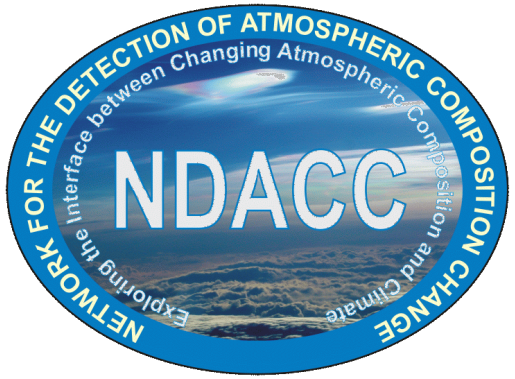
- Higher resolution satellite CO measurements can yield higher resolution OH

Scope / Limitations:

- May-Aug 2016 / 2019
- Data gaps
- Instrument bias, error, time and spatial resolutions
- Modeling bias, error, omissions, assumptions

Data Collection & Instrumentation

- Satellite retrievals
  - MOPITT (Measurement of Pollution in the Troposphere)
  - CrIS (Cross-Track Infrared Sounder) - CLIMCAPS
  - TROPOMI (Total Carbon Column Observing Network)
- Ground-up retrievals
  - NDACC (Network for the Detection of Atmospheric Composition Change)
- Chemical Transport Models (CTM)
  - GEOS-Chem
  - GEOS-Chem Adjoint



Methods

Part 1: CO Analysis

- Cross compare satellite CO retrievals
- Compare with ground-up data
- Compare with GEOS-Chem model

Part 2: OH Output

- Determine OH after CO observation assimilation into GEOS-Chem Adjoint
- Compare instrument differences

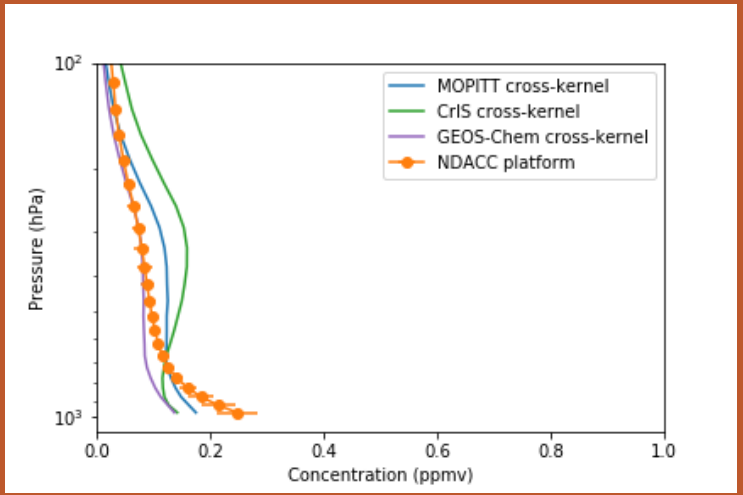
Part 3: Sensitivities

- GEOS-Chem adjoint to determine CO sensitivities to OH reaction
- Understand instrument measurements/ characteristics

Initial Results

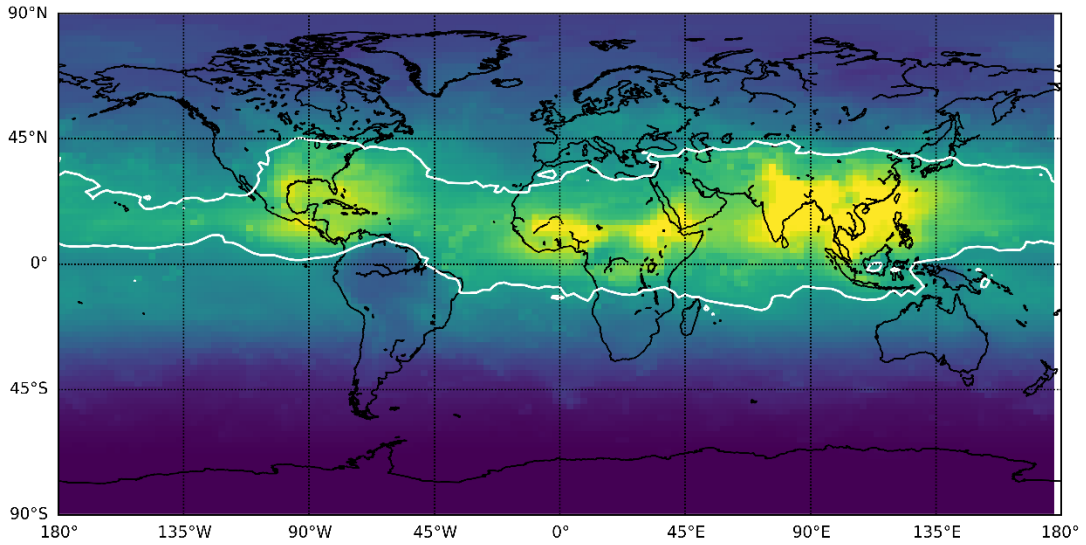
Part 1: CO Analysis

(example: cross-comparison over Toronto NDACC station)



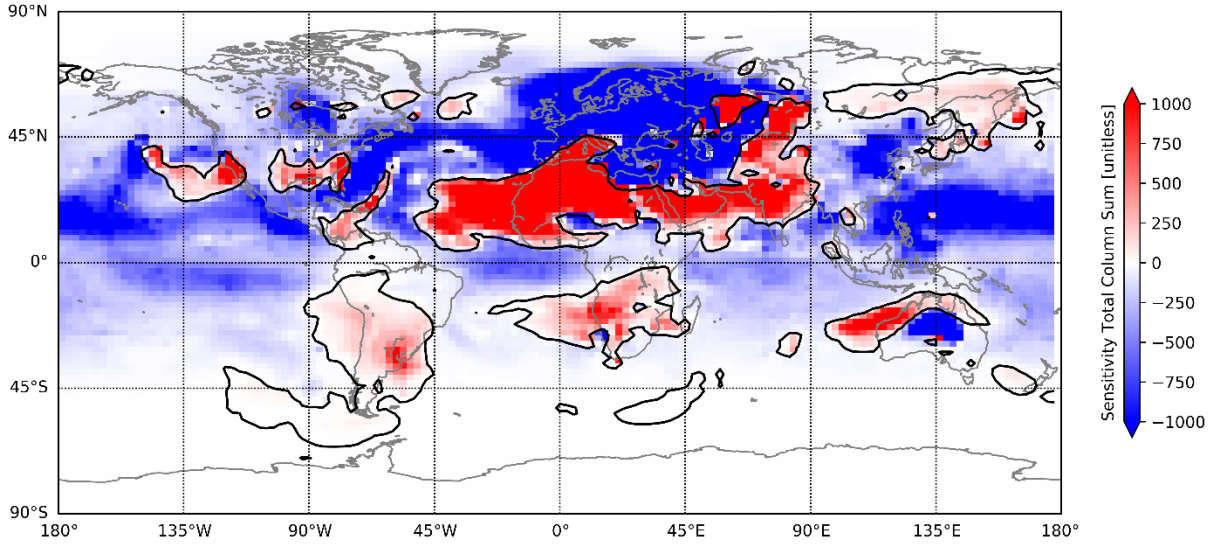
Part 2: OH Output

(example: OH total column after MOPITT CO assimilation)



Part 3: Sensitivities

(example: CH_4+OH reaction sensitivity)



Conclusions

- Part 1: CO Analysis
  - TROPOMI total column accuracy is promising
  - CLIMCAPS profile accuracy is expected to be high
- Part 2: OH Outputs
  - Ongoing
  - Compare OH resolutions between assimilated observing platforms
- Part 3: Sensitivities
  - Ongoing
  - Reveal model and instrument characteristics

- Possible future investigation:
  - Assess Joint CrIS-TROPOMI product
  - Compare whole year(s) data, monthly/annual trends, interannual variations

Goal:

- Should provide insight into OH reaction rates with CO, and whether CO could be used to estimate OH